ULTRASONIC VELOCITY IN ORGANIC SOLUTIONS II

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ABSTRACT. In this paper is reported the ultrasonic velocities and adiabatic compressibilities of solutions of benzoic acid in absolute alcohol, iso-butyl alcohol and carbon tetrachloride at various temperatures.

The results are in agreement with those reported in the previous paper.

INTRODUCTION

In a paper recently communicated the author (Lal, 1950) gave experimental determinations of ultrasonic velocities in solutions with a solid solute. It was observed that the presence of a solid, however small it may be, always lowers the velocity. The present paper forms a continuation of the series, the investigations being on the following solutions.

1. Benzoic acid in ethyl alcohol.
2. Benzoic acid in iso-butyl alcohol.
3. Benzoic acid in carbon tetrachloride.

The experimental arrangement is the one followed in earlier investigations and it has been described in full in the first paper.

The liquids were of the purest stock and used after distillation; the solid benzoic acid was recrystallised.

The frequencies and the temperatures at which the determinations were made, are noted against each solution.

RESULTS

The following tables contain the results of determination of ultrasonic velocities in the solutions at different temperatures and concentrations.

TABLE I. Benzoic acid and ethyl alcohol solutions.

(*a*) *Variation of velocity and adiabatic compressibility with concentration.*

No.	Concentration	Temperature °C	Density gms./c.c.	Frequency Mc/sec.	Velocity Metres/sec.	Adiabatic-compressibility $\times 10^6$
1.	M/5	28	0.7990	4.275	1102	115.10
2.	M/10	28.5	0.7961	4.380	1107	114.90
3.	M/15	28.5	0.7937	4.325	1113	114.71
4.	M/20	29.5	0.7923	4.425	1122	113.98
5.	Pure Alcohal	29.5	0.7905	4.425	1158	110.70

TABLE I (*contd.*).

No.	Concentration	Temperature °C	Frequency Mc/sec	Velocity. Metres/sec.
1.	M/5	18	4.275	1110
2.	M/10	18	4.380	1116
3.	M/15	18	4.275	1145
4	M/20	18	4.275	1158
5.	Pure ethyl alcohol	18	4.275	1172

No.	Concentration	Temperature °C	Frequency Mc/sec.	Velocity. metres/sec
1.	M/5	2.8	4.425	1132
2.	M/10	2.8	4.380	1179
3.	M/15	3	4.275	1215
4.	M/20	2.8	4.275	1220
5.	Pure ethyl alcohol	2.8	4.275	1252

(*b*) *Variation of velocity with temperature.*

No.	Concentration	Temperature °C	Velocity metres/sec
1.	M/5	28	1102
		18	1110
		10	1122
		2.8	1132
2.	M/10	28.5	1107
		18	1116
		10	1143
		2.8	1179
3.	M/15	28.5	1113
		18	1145
		7	1197
		2.8	1215
4.	M/20	29.5	1122
		18	1158
		2.8	1220
5.	Pure ethyl alcohol	29.5	1158
		18	1172
		9	1201
		2.8	1252

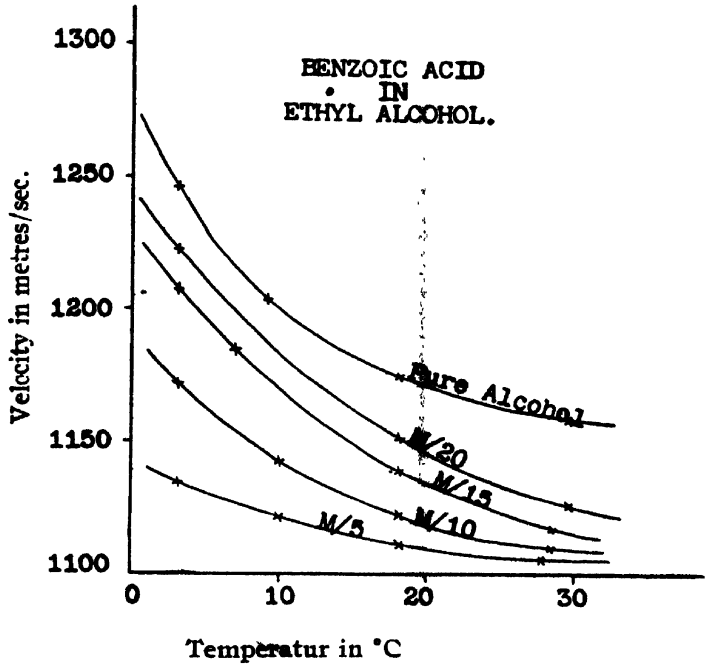

FIG. 1

TABLE II. Benzoic acid in iso-butyl alcohol.

(a) Variatian of velocity and adiabatic compressibility with concentration.

No.	Concentration	Temperature °C	Density gms/c.c.	Frequency Mc./sec.	Velocity Metres/sec.	Adiabatic-compressibility × 10^6
1.	M/5	28.5	0.8036	4.655	1197	88.01
2.	M/10	29	0.7996	4.65	1204	87.42
3.	Pure iso-butyl alcohol	29	0.7951	4.45	1212	86.36

No.	Concentration	Temperature °C	Frequency Mc/sec.	Velocity metres/sec.
1.	M/5	20	4.655	1234
	M/10	20	4.65	1246
	Pure iso-butyl alcohol	20	4.75	1252
2.	M/5	10	4.655	1276
	M/10	10	4.65	1284
	Pure iso-butyl alcohol	10	4.75	1289
3.	M/5	4.5	4.655	1298
	M/10	4.5	4.65	1305
	Pure iso-butyl alcohol	4.6	4.75	1312

(*b*) *Variation of velocity with temperature.*

No.	Concentration	Temperature °C	Velocity metres/sec
1.	M/5	28.5 20 10 4·5	1197 1234 1276 1298
2.	M/10	29 20 10 4·5	1204 1246 1284 1305
3.	Pure iso-butyl alcohol	29 20 10 4.6	1212 1252 1289 1312

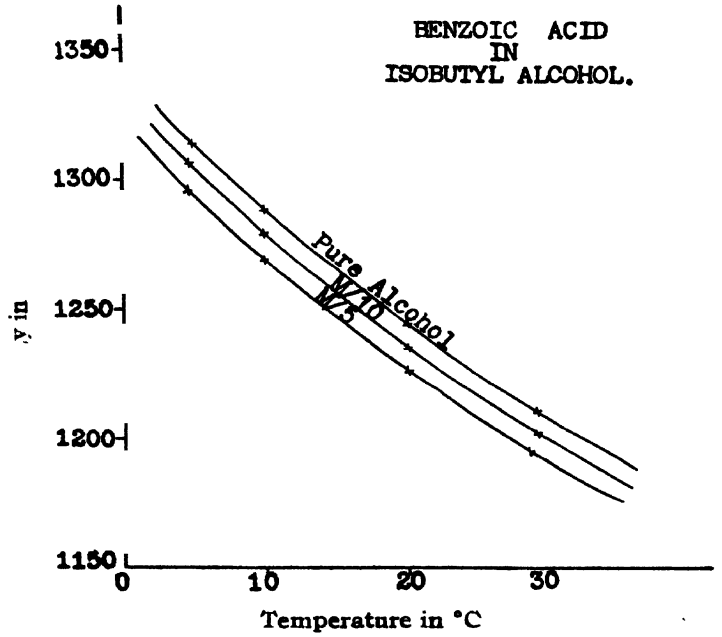

FIG. 2

TABLE III. Benzoic acid and carbon tetrachloride solution.

(*a*) *Variation of velocity and adiabatic compresslbility with concentration.*

No.	Concentration	Temperature °C	Density gms/c.c.	Frequency Mc/sec.	Velocity metres/sec.	Adiabatic compressibility $\times 10^6$
1.	M/5	31	1.556	4.13	819	79·5
2.	M/10	31	1.560	4.13	823	78.9
3.	M/15	31	1.562	4.13	825	78.6

No.	Concentration	Temperature. °C	Frequency Mc/sec	Velocity metres/sec.
1.	M/5	20	4.13	833
	M/10	20	4.13	840
	M/15	20	4.13	845
2.	M/5	10	4.13	852
	M/10	10	4.13	869
	M/15	10	4.13	880
3.	M/5	2.6	4.13	884
	M/10	2.6	4.13	901

(*b*) *Variation of velocity with temperature.*

No.	Concentration	Temperature °C	Velocity metres/sec.
1.	M/5	31	819
		20	833
		10	852
		2.6	884
2.	M/10	31	823
		20	840
		10	869
		2.6	901
3.	M/15	31	825
		20	845
		10	880

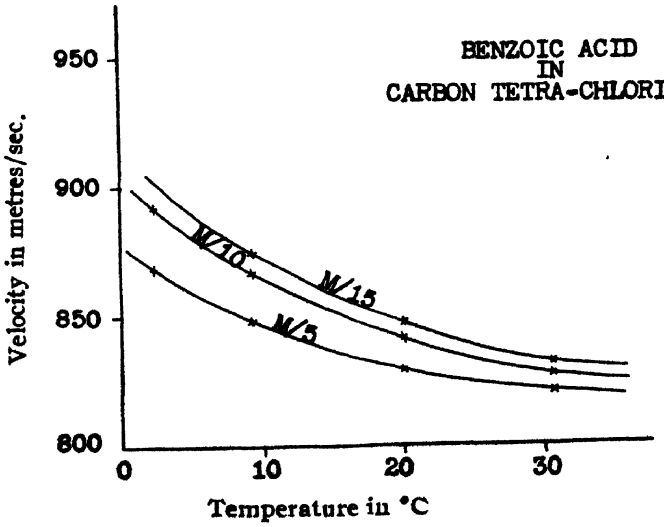

FIG. 3

INFERENCES

The results are in agreement with those reported in the first paper. They are:

1. The velocity in a pure solvent is always greater than that in the solution.

2. The presence of a solid constituent, however small, always lowers the velocity.

3. The velocity in a solution increases with dilution.

4. The adiabatic comperessibility in a solution increases with concentration.

5 The ultrasonic velocity in a solution decreases with the rise in temperature.

Discussion on the above results will be given in subsequent papers.

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REFERENCES

Lal, K. C., 1950, *Ind. Jour. Phy.*, **24**, 461.